New bats (Mammalia: Chiroptera) and new records of bats from Borneo and Malaya

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Introduction

Although numerous bat species are known from Sabah, many records (Medway, 1977) originate in collections made from Mount Kinabalu or from the montane region of which it forms a part. Bats from the lowland areas of Sabah have received less attention and moreover many records are of cavernicolous species. One of us (CMF) has since 1981 been working as a Canadian volunteer (CUSO) for the Wildlife Branch of the Sabah Forest Department. While the principal activity in Sabah has been the management of edible-nest swiftlets (*Collocallia*) and the study of the rain forest avifauna, it has also been possible to capture and study bats, of which a proportion has been retained as museum specimens for taxonomic and record purposes. Some 65 species have been obtained, including three hitherto undescribed, some, including a new subspecies, representing new distributional records for Borneo, and others of taxonomic or more local distributional interest. This account is limited to the novelties that have been obtained, to those specimens that constitute new records for Borneo, and those that represent taxa so far poorly known. A single new record for Malaya has also been included.

The majority of the bats were caught using harp-style traps (Tuttle, 1974; Tidemann & Woodside, 1978). Usually these were placed across narrow trails or streams in the rain forest, or near cave openings. Some bats were also caught in standing mist nets, others by hand or with a butterfly net at their roosts in caves. All trapping has been done at or near ground level, with no work being attempted in the canopy.

Most of the collecting has been carried out either at Gomantong or Sepilok. The first of these, several miles north of the Kinabatangan River, about 20 miles south of Sandakan, has a network of limestone caves surrounded by both primary and secondary forest. Large colonies of several species of bats roost in the caves, while many other species are found in the vicinity. Bats from the Gomantong Caves were collected in 1929 by F. N. Chasen, and in 1930 by Senior Forest Ranger P. Orolfo (Chasen, 1931). More recently, Gomantong has been visited by the members of a Japanese group, in 1976 and 1979, the bats collected being reported by Kobayashi *et al.* (1980). These workers also obtained bats at the Madai Caves, whence some of those reported here originate. Sepilok is a virgin jungle reserve located near Sandakan and maintained by the Sabah Forest Department as a research area and wildlife sanctuary. Limited collecting has also been carried out at other sites which are summarized in Table 1.

Many of the more interesting specimens have been donated to the British Museum (Natural History), as have the holotypes of the new taxa described in this paper. All are denoted by their accession numbers, prefixed BM(NH). The final disposition of the remainder of the specimens examined in London has yet to be decided: all are indicated in this account by their original collector's numbers, prefixed CMF. Duplicates of some of these, together with those specimens that were not sent or brought to London since they represent

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Table 1 Major localities whence bats have been obtained

Gomantong	5°31′N, 118°04′E.	30 m	Limestone caves, in primary dipterocarp forest
Baturong	4°42′N, 118°00′E.	80 m	Limestone caves, in primary dipterocarp forest
Madai	4°43′N, 118°09′E.	80 m	Limestone caves, in logged dipterocarp forest
Panggi	5°31′N, 118°18′E.	150 m	Limestone caves, in logged dipterocarp forest
Segarong	4°34′N, 118°25′E.	30 m	Limestone caves near the sea, in secondary forest and mangrove
Sepilok	5°52′N, 117°56′E.	30 m	Primary dipterocarp forest
Lumerau	5°12′N, 118°52′E.	40 m	Primary dipterocarp forest
Sungei Labau, Witti Range	5°16′N, 116°30′E.	300 m	Primary dipterocarp forest
Silabukan	5°11′N, 118°47′E.	300 m	Primary dipterocarp forest
Rinangisan, Crocker Range	c. 5°40′N, 116°20′E.	110 m	Montane forest
Kinabalu National Park	6°02′N, 116°32′E.	1500 m	Montane forest
Menggadong	4°58′N, 115°28′E.	30 m	Kerangas Forest

species already well known in Borneo or of common occurrence will be maintained as a reference collection at Sepilok by the Sabah Forest Department.

All measurements are in millimetres: those of individual teeth have been made with a stereoscopic microscope and traversing micrometer stage, others with a dial micrometer.

Systematic section

Rousettus spinalatus Bergmans & Hill, 1980

Rousettus spinalatus Bergmans & Hill, 1980 : 95. In or near Medan, or in or near Prapat, N Sumatra.

SPECIMEN EXAMINED. ♂ CMF 0100 Panggi, Sabah (in alcohol, skull extracted).

REMARKS. This is the second example of *Rousettus spinalatus* to be recorded from Borneo, the first being a subadult female obtained at Niah Great Cave in Sarawak and reported by Bergmans & Hill in the original account. As in the original specimens, the wings in this example from Sabah are inserted on the spinal line and there is no longitudinal dorsal band of fur down the centre of the back. Dentally this specimen agrees closely with the example from Niah, although in the Sabah specimen, as in that from Niah, m^1 is slightly wider than the corresponding tooth in *R. amplexicaudatus*, not narrower as it is said to be in the original description. As in the Niah example, m^2 and m_3 are longer, wider and more massive than in *R. amplexicaudatus,* and m^2 is approximated more closely to the rear edge of the palate at the zygomatic insertion than in that species. A specimen (♀ CMF 0109) of *R. amplexicaudatus* was collected at Panggi on the day following that on which this example of *R. spinalatus* was obtained.

Measurements: length of forearm 86·9; thumb (c.u.) 25·3; II^{m} 33·4; II^{1} 7·1; II^{2} 5·4; III^{m} 50·6; III^{1} 31·7; III^{2} 41·4; IV^{m} 49·2; IV^{1} 24·0; IV^{2} 28·4; v^{m} 47·7; V^{1} 22·4; V^{2} 26·4; length of ear 17·6; length of tibia 33·3; length of foot (c.u.) 17·9; greatest length of skull 34·9; condylobasal length 32·8; condylocanine length 31·7; rostral length (front of orbit to prosthion) 12·0; rostral length (front of orbit to tip of nasals) 11·4; palatal length 17·5; palatilar length 16·8; length palation—incisive foramina 16·0; length palation—basion 13·0; lachrymal width 10·0; least interorbital width 8·1; least postorbital width 7·8; zygomatic width 22·2; width of braincase 14·8; mastoid width 13·8; orbital diameter 8·6; c^1–c^1 (crowns) 6·7, (alveoli) 6·4; c^1–c^1 (internally, cingula) 3·8; pm^4–pm^4 (internally) 5·1; m^2–m^2 (crowns)

10·5; (alveoli) 10·4; width of mesopterygoid fossa 4·5; c–m^2 (crowns) 12·9, (alveoli) 12·7; length of complete mandible from condyles 25·6; length right ramus from condyle 27·1; mandibular height (angular process to tip of coronoid process) 11·5; c–m$_3$ (crowns) 14·3, (alveoli) 14·2. Length/width of cheekteeth: pm^3 2·19/1·31; pm^4 2·33/1·89; m^1 2·82/2·07; m^2 2·04/1·54; pm$_1$ 1·19/1·28; pm$_3$ 2·16/1·25; pm$_4$ 2·38/1·62; m$_1$ 2·51/1·56; m$_2$ 2·21/1·61; m$_3$ 1·63/1·20.

Chironax melanocephalus (Temminck, 1825)

Pteropus melanocephalus Temminck, 1825 : 190, pls 12, 16, figs 3, 4. Bantam, Java.

SPECIMEN EXAMINED. ♀ CMF 830105.1 Sepilok, Sabah (in alcohol, skull extracted).

REMARKS. *Chironax melanocephalus* has not before been reported from Borneo although known from southern Thailand, Malaya, Sumatra, Nias Island, Java and Sulawesi. The species was reviewed in some detail by Hill (1983) who reported further specimens from Sumatra, Java and Sulawesi and provided comparative notes.

This specimen agrees with those from the mainland, from Sumatra and from Java in the presence of a small antero-external supplementary cusp on the second upper premolar (pm^3) rather than with Sulawesian examples from which this cusp is absent. In most points of wing structure it is similar to specimens from the Malay Peninsula, Sumatra and Sulawesi, conforming to these in the relative lengths of the third, fourth and fifth metacarpals rather than with Javan examples in which these digital components are relatively slightly shorter, the third metacarpal especially so. The second phalanges of the fourth and fifth digits, however, are relatively a little shorter than those in most specimens from the mainland and from Sumatra, in this respect approaching or agreeing with specimens from Java and Sulawesi.

This female specimen has diffuse pale orange neck tufts (from specimen in alcohol): otherwise dorsally the pale based pelage is tipped with dark brown except on the head where the pelage is blackish, while ventrally it is pale greyish brown, becoming buffy on the throat and flanks.

Measurements (wing indices in parentheses): length of forearm 45·6 (1000); III^m 31·6 (693); III^1 22·4 (491); III^2 28·4 (622); IV^m 30·5 (669); IV^1 16·9 (371); IV^2 16·7 (366); V^m 30·2 (662); V^1 14·8 (325); V^2 15·5 (340); greatest length of skull 22·7; condylobasal length 22·0; condylocanine length 21·0; length front of orbit–tip of nasals 5·4; length orbit–nares 5·0; length orbit–gnathion 6·9; palatal length 11·6; length palation–incisive foramina 9·8; length palation–basion 8·6; lachrymal width 6·1; least interorbital width 4·4: least postorbital width 5·1; zygomatic width ---; width of braincase 9·8; mastoid width 10·6; orbital diameter 5·8; c^1–c^1 (crowns) 4·5, (alveoli) 4·2; (cingula, internally) 2·1; pm^4–pm^4 (crowns) 6·7, (alveoli) 6·2, (internally) 4·0; m^1–m^1 (crowns) 6·4. (alveoli) 6·0; width mesopterygoid fossa 3·1; c–m^1 (crowns) 7·3; length complete mandible from condyles 15·7; length right ramus from condyle 16·6; coronoid height 8·5; c–m$_2$ (crowns) 8·2.

Hipposideros bicolor bicolor (Temminck, 1834)

Rhinolophus bicolor Temminck, 1834 : 19, pl. 1, fig. 3; 1835 : 18 (further description). Anjer coast, northwestern Java (Tate, 1941).

SPECIMENS EXAMINED. ♂♂ BM(NH) 83.66, 83.340 (in alcohol, skulls extracted), ♀ CMF 821212.2 (in alcohol) Gomantong, Sabah; imm. ♀ BM(NH) 83.339 Panggi, Sabah (in alcohol).

REMARKS. Peters (1869) listed *Hipposideros bicolor* from Sarawak but according to Medway (1977) the records of this species from central Borneo by Jentink (1897) are based on specimens of *H. dyacorum*. The adults of these from Sabah agree closely in size with one of *H. bicolor* from Java reported by Hill (1983) and are thus referred to the nominate subspecies rather than to *H. b. atrox* Andersen, 1918 which has a slightly smaller skull (condylocanine length (7) 15·4–15·9), although the differences are slight. This subspecies extends through the Malay Peninsula to the islands of Terutau, Tioman and Sumatra. Bornean specimens are considerably larger externally and cranially than *H. b. erigens* Lawrence, 1939 from the Philippine Islands.

Measurements (BM(NH) 83.66, 83.340, CMF 821212.2, in that order, cranial dimensions of 83.66 and 83.340): length of forearm 46·8, 45·5, 46·7; length of ear 16·7, 17·0, 17·5; length of tail 31·8, 29·9, 28·6; length of tibia 20·5, 19·5, 20·4; length of foot (c.u.) 8·0, 8·1, 8·3; greatest length of skull 18·9, 19·0; condylobasal length 16·6, 16·7; condylocanine length 16·4, 16·4; basal length 14·7, 14·8; palatal length 6·6, 6·6; width across rostral swellings 4·6, 4·5; least interorbital width 2·7, 2·7; zygomatic width 9·1, 9·2; width of braincase 8·5, 8·5; mastoid width 9·2, 9·5; c^1–c^1 (alveoli) 3·9, 3·9; m^3–m^3 6·0, 6·1; c–m^3 6·3, 6·5; m^{1-3} 3·9, 4·0; length complete mandible from condyles 11·4, 11·4; length right ramus from condyle 11·9, 12·0; c–m_3 6·8, 6·9.

Hipposideros ater Templeton, 1848

Hipposideros ater Templeton, 1848 : 252. Colombo, Sri Lanka.

SPECIMENS EXAMINED. ♂♂ BM(NH) 83.67—69 Gomantong (in alcohol, skulls extracted; ♂ CMF 821105.13 Madai (in alcohol).

REMARKS. There is no previous record of *Hipposideros ater* from Borneo although the species extends from India though southeastern Asia to Australia. It is difficult to allocate these specimens to subspecies since although in several points of size they agree closely with *H. a. saevus* Andersen, 1918 (S. Thailand to the Molucca Islands) or with *H. a. antricola* (Peters, 1861) (Philippine Islands) the sole complete skull is a little longer than in either of these. The anterior lower premolar (pm_2) is rather less than one half the length of the second lower premolar (pm_4) and about one half its height, as in *H. a. ater* from India and Sri Lanka or in *H. a. antricola* in which this tooth is also considerably reduced. For the present, therefore, specimens from Sabah are left unallocated: few examples are available for comparison and there are few published measurements of *H. a. antricola*.

Measurements (BM(NH) 83.67—69 in that order, forearm only of CMF 821105.13): length of forearm 40·4, 40·8, 40·7, 40·5; condylocanine length 15·3, ——, ——; width across rostral swellings 4·2, 4·3, 4·3; least interorbital width 2·7, 2·8, 2·9; zygomatic width 8·4, 8·3, ——; width of braincase 7·7, ——, ——; mastoid width 8·3, ——, ——; c^1–c^1 (alveoli) 3·5, 3·3, 3·6; m^3–m^3 5·6, 5·5, 5·7; c–m^3 5·6, 5·7, 5·7; length complete mandible from condyles 10·2, ——, 10·2; length right ramus from condyle 10·7, 10·5, 10·7; c–m_3 5·9, 6·0, 6·0.

Hipposideros cineraceus Blyth, 1853

Hipposideros cineraceus Blyth, 1853 : 410. Near Pind Dádan Khan, Salt Range, Punjab, India.
Phyllorhina micropus Peters, 1872: 256. Dehra Dun, near Simla, NW India.
? *Hipposideros wrighti* Taylor, 1934 : 237. Baguio, Benguet (near Headquarters gold mine), Luzon Island, Philippine Islands.

SPECIMENS EXAMINED. 2♂♂. 2♀♀ BM(NH) 83.341–344 Segarong, Sabah (in alcohol, skulls extracted); ♀ CMF 830221.2 Baturong, Sabah (in alcohol).

REMARKS. Andersen (1918) first listed Borneo within the distribution of *Hipposideros cineraceus,* probably on account of BM(NH) 10.4.5.160 from Banjermasin. More recently, Phillips (1967) has reported *H. c. cineraceus* from tidal caves in Sabah, at Tanjong Perawan, 4 miles north of the Bengkoka River, and at Tanjong Berungus, farther northward from the same river.

The species ranges from Pakistan eastwards through Indochina and Malaya to Borneo but has not been recorded from Sumatra or from Java. There is some variation in size (Table 2) over this extensive distribution, those from Borneo having forearms generally longer than those from Pakistan, India and Burma: those from Thailand and Malaya are to some extent intermediate in this respect. Bornean specimens average slightly larger in skull size than examples from the mainland but the difference is small. Specimens reported by Phillips (1967) agree in size with those recorded here: the measurement of the maxillary toothrow by this author appears to have been taken at the alveoli.

Table 2 Measurements of *Hipposideros cineraceus*

	Length of forearm	Condylocanine length	m^3–m^3	c–m^3
Pakistan, India, Burma	(21) 32·3–36·1	(16) 12·7–13·7	(19) 4·7–5·1	(19) 4·8–5·2
Thailand, Malaya	(23) 34·4–38·9	(7) 12·8–13·4	(11) 4·8–5·2	(12) 4·8–5·4
Borneo	(7) 34·0–39·6	(6) 13·2–13·8	(6) 5·0–5·4	(6) 5·2–5·5
Borneo (Phillips, 1967)	(4) 36·5–38·5	(2) 13·8–13·9		(3) 5·0–5·2
BM(NH) 79.11.21.160 Holotype of *micropus* Peters, 1872	36·0	12·6	4·6	4·9

Discussion. Specimens from northern India suggest that *Phyllorhina micropus* Peters, 1872 cannot be maintained as a distinct subspecies. The taxonomic history of *Hipposideros wrighti* Taylor, 1934 from the Philippine Islands was summarized by Lawrence (1939), who concluded that Taylor might have re-described *H. ater antricola* (Peters, 1861), having wrongly assumed that *antricola* referred to a bat of the longer-eared species now called *H. bicolor*, represented in the Philippines by *H. b. erigens* Lawrence, 1939. Hill (1963) followed this lead in synonymizing *wrighti* with *H. ater antricola*. However, further study of the original description of *wrighti* suggests that in fact it may more properly represent *H. cineraceus*, having a relatively long forearm (39) and small skull (condylobasal length 13·3, rostral width 4, zygomatic width 7, c–m^3 5·3, c–m_3 5·5, length of mandible 10) that agree more nearly with the dimensions of this species rather than with *H. ater*. This contention is supported by the account of the internarial septum, which is said to be 'folded and inflated, bulbous posteriorly, separated from lateral wings by deep grooves', although in *H. ater* the internarial septum is sometimes slightly inflated and swollen. If this suggestion is correct, the distribution of *H. cineraceus* must be extended to include the Philippine Islands.

Hipposideros ridleyi Robinson & Kloss, 1911

Hipposideros ridleyi Robinson & Kloss, 1911 : 241. Botanic Gardens, Singapore.

Specimens examined. ♀ CMF 821012.1 Sepilok, Sabah (in alcohol); ♂ CMF 830716.1 Menggadong, Sabah (in alcohol; coll. F. H. Sheldon).

Remarks. This species was first recorded from Borneo by Hill (1983) who reported a single specimen from Sepilok, Sabah. Length of forearm in this further example from that locality 47·8, in the specimen from Menggadong 47·6.

Myotis montivagus borneoensis subsp. nov.

Holotype Ad. ♀ BM(NH) 83.349 Sepilok, Sabah, 5°52′ N, 117°56′ E. Collected 10 April 1983 by C. M. Francis. Orginal number CMF 830410.9. In alcohol, skull extracted.

Other material. ♂♂ BM(NH) 83.345, 83.350, ♀♀ 83.74, 83.346–348. All from type locality (in alcohol, skulls extracted).

Diagnosis. Similar in most respects to *Myotis montivagus peytoni* Wroughton & Ryley, 1913 from northeastern India but with shorter forearm and larger skull; external size nearer to *M. m. federatus* Thomas, 1916 from Malaya but skull larger; considerably larger cranially than *M. m. montivagus* (Dobson, 1874) from Yunnan and Burma; differing from all of these in a greater degree of reduction of the canines, especially of c_1, which is about the same height as the last lower premolar (pm_4) rather than slightly higher.

Description. Ear long, narrow, its anterior margin convex, terminating basally in a subsquare insertion on the head, the tip rounded, the posterior margin straight for its distal half to a broadly angular emargination, then proximally convex, a moderate rounded lobe at the base, immediately above its insertion on the head. Tragus about as long as one half the length of the ear, its tip anteriorly directed, the anterior margin slightly concave, the posterior margin convex, slightly serrate for much of its length, with a well developed triangular lobe at its base. Wing inserted at base of first toe; calcar extending rather more than halfway to tail. Pelage thick and dense, rather long. Dorsal surface (from specimens in alcohol) blackish brown, the hairs blackish brown at the base and for much of their length, tipped with dark brown or chocolate brown, the tips faintly lustrous; ventral pelage similarly blackish brown at the base, tipped profusely with paler buffy brown.

Skull broad, not especially elongate, with broad braincase, low sagittal crest, wide interorbital region and widely flared zygomata; rostrum low and broad, in profile concave at frontal region, the anteorbital foramen separated from the orbit by a wide bar of bone; shallow frontal depression; narial emargination narrow, rounded, extending posteriorly about halfway to anteorbital foramina; palate wide posteriorly, with narrow anterior emargination extending posteriorly almost to a line joining the rear faces of c^1–c^1; short bony post-palatal extension; shallow, rounded basioccipital pits.

Inner upper incisor (i^2) small, bicuspid, rounded, with larger anterior cusp and smaller posterior cusp; outer upper incisor (i^3) short and wide, about twice bulk of inner tooth, with large central cusp flanked by small lateral cusps; anterior upper premolar (pm^2) small, about equal to i^3 in bulk, in contact with c^1 and posterior upper premolar (pm^4); second upper premolar (pm^3) minute, recessed between inner face of pm^2 and antero-internal face of pm^4, intruded from row; m^3 with three well developed commissures; lower incisors strongly arched forward, the first and second (i_{1-2}) small, tricuspid, third (i_3) at least twice the bulk of i_2 with irregularly cuspidate crown; c_1 small, about as high as the posterior lower premolar (pm_4) or slightly shorter; anterior lower premolar (pm_2) about one and one half times the bulk of i_3; second lower premolar (pm_3) minute, almost wholly intruded from row, partially recessed between postero-internal face of pm_2 and antero-internal face of pm_4.

Measurements appear in Table 3.

ETYMOLOGY. The subspecific name alludes to the provenance of this new subspecies.

REMARKS. Hill (1962) discussed the status of *M. montivagus* in some detail, giving measurements of specimens in the British Museum (Natural History) and associating *peytoni* and *federatus* with *montivagus*. This new subspecies from Borneo differs principally from the three mainland forms in greater cranial size, being especially larger than the nominate subspecies from Yunnan and Burma. Reduction and displacement of the second lower premolar (pm_3) varies within the species. In *M. m. montivagus* pm_3 is in the toothrow although compressed tightly between pm_2 and pm_4; in *M. m. peytoni* pm_3 may be in the row or partially intruded from it, while in *M. m. federatus* and *M. m. borneoensis* the tooth is almost wholly intruded from the row.

Myotis ridleyi (Thomas, 1898)

Pipistrellus ridleyi Thomas, 1898 : 361. Selangor, Malaya.

SPECIMENS EXAMINED. ♂, ♀ (BM(NH) 82.553–554 Sungei Labau, Witti Range, Sabah, 300 m (in alcohol, skull of 83.553 extracted); ♂ BM(NH) 83.75, ♀ CMF 821201.1 Sepilok, Sabah (in alcohol, skulls extracted).

REMARKS. Definitive records of this species have been confined hitherto only to Malaya, but it probably occurs also in Sumatra (Hill, 1969; Hill & Topal, 1973). These examples from Borneo are closely similar to Malayan specimens in the British Museum (Natural History).

External measurements (BM(NH) 82.553–554, 83.75, CMF 821201.1, in that order): length of forearm 28·4, 31·1, 28·8, 29·1; length of ear 11·2, 11·6, 11·1, 11·3. *Cranial measurements* (BM(NH) 82.553, 83·75, CMF 821201.1, in that order): greatest length of skull 11·8, 12·1, 12·2; condylobasal length 11·4, 11·6, 11·6; condylocanine length 10·8, 11·0, 11·0; width across anteorbital foramina 3·5, 3·4, 3·5; zygomatic width ——, 7·8, 7·9; least interorbital width 3·0, 2·9, 3·0; width of braincase 6·0, 5·9, 5·8; mastoid

Table 3 Measurements of *Myotis montivagus*

	M. m. borneoensis ♀ BM(NH) 83.349 Holotype	*M. m.* *borneoensis* Sabah	*M. m.* *peytoni* NE India	*M. m. federatus* ♀ BM(NH) 16.4.20.5 Holotype. Malaya	*M. m.* *montivagus* Yunnan, Burma
Length of forearm	42·2	(7) 42·2–44·8	(7) 45·0–47·0	39·0	(3) 40·0–41·5
Length of ear	15·1	(7) 15·1–16·1	(7) 15·0–15·5	—	(3) 8·5–14·5
Greatest length of skull	17·4	(7) 17·2–17·6	(7) 16·5–16·9	16·4	(2) 15·2, 15·4
Condylobasal length	16·5	(7) 16·4–16·9	(6) 15·9–16·3	15·7	(2) 14·7, 14·8
Condylocanine length	15·7	(7) 15·6–16·3	(6) 15·1–15·6	15·0	(2) 14·0, 14·1
Length anteorbital foramen–orbital rim	1·4	(7) 1·2–1·5	(7) 1·3–1·5	1·3	(3) 1·1–1·5
Least interorbital width	4·0	(7) 3·9–4·1	(7) 3·7–4·1	3·9	(2) 3·6, 3·8
Zygomatic width	12·1	(6) 11·9–12·1	—	—	(1) 10·5
Width of braincase	7·7	(7) 7·6–7·9	(7) 7·6–8·0	7·6	(2) 7·1, 7·1
Mastoid width	8·8	(7) 8·5–9·0	(7) 8·5–8·7	8·5	(2) 7·9, 7·9
c^1–c^1 (alveoli)	4·6	(7) 4·5–4·8	(7) 4·4–4·8	4·7	(3) 4·3–4·8
m^3–m^3	7·7	(7) 7·4–7·7	(7) 7·1–7·4	7·0	(3) 6·7–6·8
c–m^3	6·9	(7) 6·7–7·0	(7) 6·5–6·7	6·4	(3) 6·0–6·1
Length complete mandible from condyles	13·1	(7) 12·9–13·6	(4) 12·2–12·8	—	(1) 11·5
Length right ramus from condyle	13·5	(7) 13·4–14·0	(7) 12·6–13·2	12·5	(3) 11·5–11·8
c–m_3	7·3	(7) 7·1–7·4	(7) 6·9–7·2	6·9	(3) 6·3–6·5

width 6·5, 6·5, 6·5; c^1–c^1 (alveoli) 3·4, 3·3, 3·4; m^3–m^3 5·4, 5·0, 5·2; c–m^3 4·3, 4·4, 4·4; length complete mandible from condyle —, —, 8·5; length right ramus from condyle —, 8·6, 8·9; c–m_3 4·5, 4·6, 4·6.

Myotis ater (?) nugax Allen & Coolidge, 1940

Myotis abbotti nugax Allen & Coolidge. 1940 : 137. Bundutuan, Mount Kinabalu, Sabah, 3500 ft.

SPECIMENS EXAMINED. ♂ BM(NH) 83·73 Cave near Gomantong; ♂ CMF 830414.1 Gomantong, Sabah (both in alcohol, skulls extracted).

REMARKS. These specimens are referred to *nugax* Allen & Coolidge without direct comparison. They agree quite closely with the original description although in the upper jaw the second premolar (pm^3), while minute, is completely or almost completely intruded from the toothrow into a recess between pm^2 and pm^4. According to Allen & Coolidge it is absent from the holotype but otherwise slightly internal to the axis of the toothrow. In the lower jaw the second premolar (pm_3) is minute and crowded inward, as these authors remark in the initial account. A further example, BM(NH) 78.1541 from Sinoa, Sabah may also represent *nugax* but pm^3_3, although very small, are not intruded from the toothrows. Clearly more material is needed to establish variability in this feature.

In life, all specimens handled by CMF from various localities in Sabah had a distinctive coloration. The upperparts were dark brown with black bases to the fur, while the underparts were a paler grey-brown, except for a golden brown patch in the centre of the belly.

Measurements (BM(NH) 83.73, CMF 830414.1, BM(NH) 78.1541, in that order): length of forearm 40·4, 41·2, 41·4; greatest length of skull 15·6, —, —; condylobasal length 14·5, —, —; condylocanine length 13·8, —, —; basal length 13·0, —, —; palatal length 8·2, —, 7·9; least interorbital width 3·7, 3·7, 3·5; zygomatic width 9·7, 10·1, —; width of braincase 7·2, 7·4, —; mastoid width 7·7, 7·9, —; c^1–c^1 (alveoli) 3·8, 3·9, 3·8; m^3–m^3 6·3, 6·5, 6·3; i^2–m^3 6·7, 6·9, 6·8; c–m^3 5·5, 5·8, 5·7; length complete mandible from condyles ——, 11·2, ——; length right ramus from condyle 11·0, 11·3, 11·9; c–m_3 6·0, 6·3, 6·2.

DISCUSSION. Tate (1941*a*) considered *nugax* probably to be the geographical representative in Borneo of *M. ater* (Peters, 1866) from the Molucca Islands, placing it in the subgenus *Selysius* rather than in *Leuconoe* to which its description as a subspecies of *M. abbotti* Lyon, 1916 would otherwise refer it. Subsequently, Hill (1962) provisionally associated *nugax* with *M. mystacinus* (Kuhl, 1819), being followed in this opinion by Medway (1965, 1977) who thought it to be a highland subspecies, both authors considering *ater* also to be a subspecies of *M. mystacinus*. More recently, Hill (1983) has reviewed the small-footed *Myotis* of south-eastern Asia and has concluded that *M. muricola* (Gray, 1846) is a distinct eastern species, rather than a subspecies of *M. mystacinus* as it was listed by Ellerman & Morrison-Scott (1951). This author, however, considered *ater* to be a species distinct from *muricola* and has suggested that the original opinion advanced by Tate that *nugax* should be referred to it as a subspecies may be correct. These Bornean specimens are similar to *M. ater* from the Moluccan islands of Buru and Ceram, although slightly larger in some respects than the largest of Moluccan *ater* measured by Hill (1983), and tend to confirm this view.

Pipistrellus cuprosus sp. nov.

HOLOTYPE. ♂ BM(NH) 83.351 Sepilok, Sabah, 5°52′ N, 117°56′ E. Collected 17 April 1983 by C. M. Francis. Original number CMF 830417.1. In alcohol, skull extracted.

OTHER MATERIAL. ♂ CMF 830417.2. Other data as holotype.

DIAGNOSIS. Similar externally and cranially to *Pipistrellus societatis* Hill, 1972 from Malaya, but differing from this species in smaller size, in more rounded, globular and less elongated braincase; in a shallower frontal depression; in wider, shallower pre-palatal emargination;

and in smaller teeth, their lingual portions in particular much reduced in comparison with the Malayan species. In some respects *P. cuprosus* resembles *P. circumdatus* (Temminck, 1840) from Java, Malaya and Burma but, apart from its considerably smaller size, like *P. societatis* it differs from this species in its more inflated frontal region, the frontal profile more nearly straight, without the distinct concavity of *P. circumdatus,* in similarly poorly defined supraorbital ridges that contrast with the more obvious ridges of that species, and in a similarly shallower, less evident frontal depression. As in *P. societatis* the narial emargination is narrower than in *P. circumdatus* and the basial pits are shallower: like *P. societatis* it differs sharply from *P. circumdatus* in its very short bony post-palate. The third upper molar (m^3) of *P. cuprosus* is a little shorter and more platelet-like than in *P. circumdatus,* as it is in *P. societatis.*

Description. Size small to medium (length of forearm 34·7–36·4); head short, with short, blunt, broad muzzle; ear large, its anterior margin strongly convex with well developed lobe at its base, the tip of the ear bluntly rounded; posterior margin of ear strongly convex, terminating at its insertion just behind the angle of the mouth in a prominent, wide quadrate lobe. Tragus with strongly concave anterior margin, rising to anteriorly directed point; upper margin of tragus nearly horizontal, strongly convexly curved posteriorly to posterior margin which is nearly straight, terminating basally in a large, rounded lobe. Ears quite heavily margined with dull white or yellowish white, the upper margin of the tragus similarly edged, a feature found to a greater or lesser extent in both *Pipistrellus societatis* and *P. circumdatus.* As in *P. societatis* there is a small wart bearing a few long hairs medianly situated just anterior to the throat, on a line joining the angles of the mouth. Wing inserted on the outside of the foot at the base of the fifth toe; calcar long as in *P. societatis* and *P. circumdatus,* extending along at least two thirds of the uropatagial margin; an extremely narrow post-calcarial lobe.

Pelage and pelage colour (from specimens in alcohol) similar to that of *Pipistrellus societatis* and *P. circumdatus.* Dorsal surface with pelage that is thick, dense and rather long, the hairs black or blackish brown at the base and for most of their length, liberally tipped with deep reddish orange or copper: in the two specimens examined the hairs over the entire dorsal surface are tipped with this brighter colour. Pelage over the crown of the head similarly tipped, the tipping slightly paler and more yellowish than on the back; as in *P. societatis* a small area of straw coloured or pale orange yellow hairs with dark brown tips just anterior to the junction of the medial aural margin with the head. These paler areas on each side merge into a transverse band of hairs that are narrowly dark based, then paler brown or straw coloured, with a narrow brownish sub-terminal annulation and pale yellowish orange tips, extending across the muzzle just in front of the eyes. As on the back, the fur on the crown and forehead is dense and long. Ventral pelage dark brown or brown, the hairs tipped with yellowish white on the upper part of the chest at the shoulders, otherwise with greyish white. Flight membranes black: fur extending on to the dorsal surface of the uropatagium but forearms and tibiae not haired.

In most points of coloration *Pipistrellus cuprosus* is similar to *P. societatis* or to *P. circumdatus.* All have the ear and tragus rimmed to some extent at least with dull white or yellowish white, black based or blackish brown based pelage that dorsally is tipped to a greater or lesser extent with yellowish, orange, russet or copper, and, in addition, all have dense, rather long fur. *Pipistrellus cuprosus* and *P. societatis,* however, apparently differ from *P. circumdatus* in the presence of an area of paler, straw coloured, dark tipped hairs at the anterior or medial base of the ear, and also in having a band of predominantly paler hairs extending across the muzzle just in front of the eyes. In *P. circumdatus* the black based, yellowish tipped fur extends unbrokenly between the ear bases and forward on to the muzzle. In both *P. cuprosus* and *P. societatis* the paler areas at the ear bases form the ends of the band of paler hairs that extends forward and across the muzzle. At the base of the ears in both the hairs are predominantly straw coloured, with dark tips; these blend into an anterior band of hairs that are narrowly dark based, then pale brown or straw coloured, with a sub-terminal brownish annulation, then tipped with yellowish.

Skull small, with rounded, globular and inflated braincase; postorbital region wide, curving abruptly to small supraorbital projections; supraorbital ridges weakly defined; braincase and frontal region elevated to produce a nearly straight rostral profile, with only a slight frontal concavity; rostrum broad, elevated posteriorly, with very slight median sulcus bounded laterally by low, rounded swellings; narial emargination narrow, more or less U-shaped; palate short and broad, the pre-palatal emargination wide, shallow, extending laterally just beyond the inner faces of i^{2-2} and posteriorly to a line joining the centres of the canines, in contrast to *Pipistrellus societatis* and *P. circumdatus* in which the emargination is deeper, reaching to a line joining the rear faces of these teeth; bony post-palate very short, with wide mesopterygoid fossa and blunt post-palatal spine; basial pits shallow.

Dentition much as in *Pipistrellus societatis*; inner upper incisor (i^2) slender, not massive as in that species but similarly bicuspid with small posterior cusp, lacking any small posterior cingulum cusp; outer upper incisor (i^3) very small, one quarter or less the basal area of i^2, with a central cusp flanked by small lateral cusps, its tip reaching only to the cingulum of i^2, the tooth separated from the canine by a narrow diastema and pushed forward so that the incisors lie on a straight line or nearly so, transversely to the longitudinal axis of the skull; anterior upper premolar (pm^2) minute, completely intruded into a recess between c^1 and the posterior upper premolar (pm^4), absent from CMF 830417.2, with no trace of any alveolus on either side; m^3 reduced, slightly platelet-like but third commissure and metacone present; i_1 and i_2 incipiently four-cusped as in *P. societatis*; i_3 shorter and wider than these teeth, with three cusps as in that species; anterior lower premolar (pm_2) about one quarter crown area of posterior lower premolar (pm_4) and about one half its height; in comparison with *P. circumdatus* the hypoconid and entoconid of m_3 slightly reduced.

Baculum (Fig. 1) very small, in tip of glans penis, with short, slender shaft, the tip slightly upcurved, the shaft supported by paired basal flanges separated posteriorly by a shallow, rounded emargination. The baculum is like that of *Pipistrellus societatis* but smaller: it differs from the baculum of *P. circumdatus* in its higher, more angular upper margin and more angular basal lobes.

Measurements of the holotype, followed by those of CMF 830417.2 and (in parentheses) of the holotype (BM(NH) 67.1605) and one other example (BM(NH) 81.1802) of *Pipistrellus societatis:* length of forearm 34·7, 36·4, (37·6, 39·4); greatest length of skull 13·6, 13·7, (15·3, 15·0); condylobasal length 12·9, 13·0, (14·4, 14·3); condylocanine length 12·7, 12·8, (14·1, 14·1); length orbit-gnathion 3·0, 3·1 (3·6, 3·9); palatal length, excluding post-palatal spine 6·1, 6·1, (6·6, 6·7); length post-palatal extension or bridge, excluding post-palatal spine (from a line joining rear faces of m^{3-3} to palation) 4·7, 4·8, (5·0, 5·1); width across anteorbital foramina 4·7, 4·7, (5·1, 5·2); lachrymal width 6·1, 6·2 (6·7, 6·8); width across supraorbital tubercles 5·5, 5·8, (6·0, 6·0); least interorbital width 4·1, 4·1, (4·3, 4·3); zygomatic width 9·6, 10·1, (10·4, 10·5): width of braincase 7·4, 7·7, (7·9, 7·5); mastoid width 7·6, 8·0, (8·5, 8·4); c^1–c^1 (alveoli) 4·3, 4·4, (4·6, 4·8); m^3–m^3 6·5, 6·4, (6·7, 7·0); c–m^3 4·9, 4·8, (5·2, 5·5); length complete mandible from condyles 9·4, 9·5, (10·4, 10·6); length right ramus from condyle 9·9, 10·0, (10·8, 11·0); c–m_3 5·2, 5·3, (5·6, 5·9)

ETYMOLOGY. The specific name alludes to the coppery bronze tipping of the dorsal pelage of this attractive new species.

DISCUSSION. Heller & Volleth (1984) have examined five examples of *Pipistrellus societatis* from the Ulu Gombok Field Studies Centre, near Kuala Lumpur, Selangor, Malaya. Without direct comparison they consider *societatis* to be a lowland subspecies of *P. circumdatus.* Their measurements, however, demonstrate quite clearly the short palate (palatal length 6·7–6·9 in *societatis,* 7·6–8·6 in *circumdatus*) and the short bony post-palate (length palatal extension or bridge 5·1–5·4 in *societatis,* 6·1–6·8 in *circumdatus*) that are among the most obvious distinguishing features of *societatis,* and also its considerably shorter toothrows (c–m^3 5·3–5·6 in *societatis*, 5·9–6·4 in *circumdatus*; c–m_3 5·5–5·9 in *societatis*, 6·3–6·7 in *circumdatus*). Moreover, other distinguishing features have been indicated in this account and these, together with the discovery of a smaller species clearly more closely allied to *societatis* than to *circumdatus* suggest that *societatis* should be retained as a distinct species.

In the same study Heller & Volleth have examined the karyological features and baculum of *Pipistrellus societatis*, transferring these to *P. circumdatus* (which they have not seen) as a consequence of their inclusion of this taxon in that species. According to these authors these features indicate that *P. circumdatus* (sic) should be transferred to *Eptesicus*, the presence or absence of the anterior upper premolar (pm^2) having proved unreliable as a diagnostic character separating *Pipistrellus* and *Eptesicus*. Indeed, this tooth is absent from one of the specimens of *P. societatis* that they examined, as it is from one of those of *P. cuprosus* here described. Instability of this character is of course well known in certain species of *Pipistrellus*.

The karyological evidence advanced by Heller & Volleth cannot be readily evaluated since many of the species of these nominal genera remain to be studied. The baculum (Fig. 1) of *P. societatis*, however, differs in some respects from that of *P. circumdatus*, but both are similar to that of *P. subflavus* from North America. Both differ from the more triangular baculum often associated with *Eptesicus* in the presence of a short shaft. On a wider front Heller & Volleth also transfer the Australian *Eptesicus douglasi, E. pumilus, E. vulturnus, E. regulus* and *E. sagittula* to *Pipistrellus*, together with the African *E. capensis*, the first four of these at least having bacula of the long shafted type that characterizes many species of that genus. Current studies of the bacula of the nominal genera *Pipistrellus* and *Eptesicus* in London and Sevenoaks (the Harrison Zoological Museum) indicate a wide variety of bacular structure and in these circumstances we prefer to retain the *circumdatus* group (and thus *circumdatus, societatis* and *cuprosus*) in *Pipistrellus*, at least until this matter is more fully resolved.

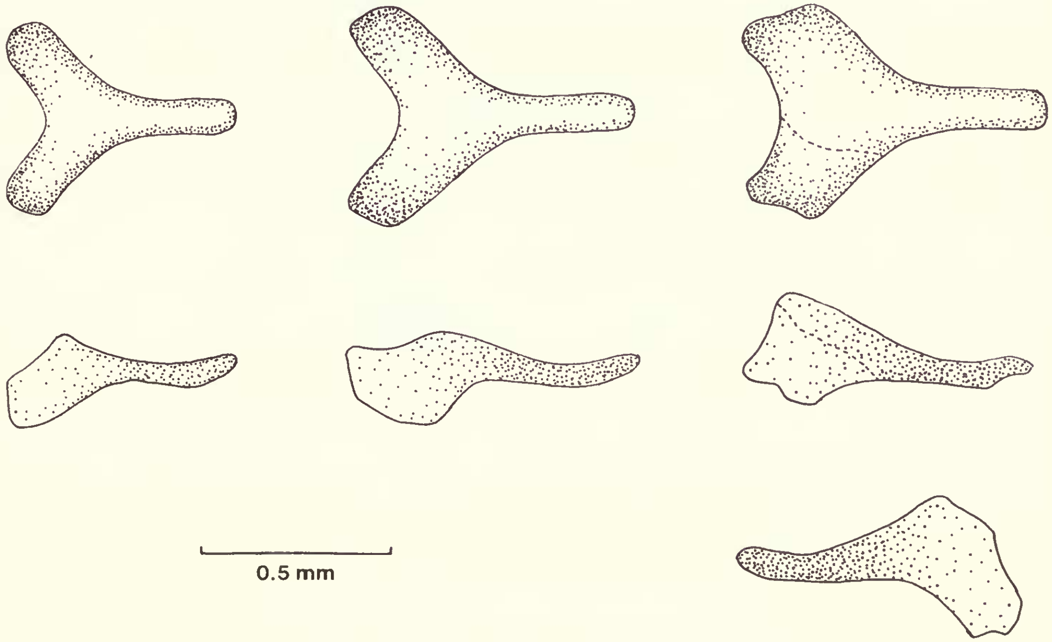

Fig. 1 Dorsal (above) and lateral (below) aspect of the baculum of: left, *Pipistrellus cuprosus*, BM(NH) 83.351, holotype, Sabah; right, *P. societatis*, BM(NH) 67.1605, holotype, Malaya; and centre, *P. circumdatus*, BM(NH) 73.618, Malaya. Lateral aspect is of right face of baculum except for *P. societatis*, both lateral faces of the damaged baculum being illustrated. (*Pipistrellus societatis, P. circumdatus* from drawings prepared by D. L. Harrison, Harrison Zoological Museum, Sevenoaks, England.)

Pipistrellus macrotis (Temminck, 1840)

Vespertilio macrotis Temminck, 1840 : 218. Padang, Sumatra.

SPECIMEN EXAMINED. ♂ CMF 830901.1 Kuala Selangor, Malaya (in alcohol, skull extracted).

REMARKS. This specimen is the first of *Pipistrellus macrotis* to be recorded from Malaya. It corresponds closely with the original description by Temminck: like the closely related *P. vordermanni* (Jentink, 1890) from Billiton Island and Borneo it may be recognized readily by its large ears, slightly hatchet-shaped tragus with anteriorly directed point, and by its white or whitish wings. As in *P. vordermanni* the skull is short with a rather globose braincase and a short, broad rostrum with small supraorbital tubercles, strong zygomata that are well developed jugally, and deep basioccipital pits. The anterior upper premolar (pm^2) is very small, completely intruded into a recess between the canine and the posterior upper premolar (pm^4), as in *P. vordermanni,* while the anterior lower premolar (pm_2) is similarly much reduced.

Measurements: length of forearm 33·5; length of ear 14·1; greatest length of skull 12·4; condylobasal length 11·7, condylocanine length 11·5; width across supraorbital tubercles 4·6; zygomatic width 8·5; least interorbital width 3.7; width of braincase 6·6; mastoid width 7·4; c^1–c^1 (alveoli) 4·3; m^3–m^3 5·4; c–m^3 4·1; length complete mandible from condyles 8·0; length right ramus from condyle 8·4; c–m_3 4·3.

DISCUSSION. This Malayan example of *P. macrotis* is in good agreement with a single specimen (BM(NH) 23.1.2.12) from Sebang, Sumatra, measured by Hill (1983). Like this Sumatran example, it differs from *P. vordermanni* from Borneo only in slightly larger size and in rather whiter wings. As in Bornean *P. vordermanni* the translucent uropatagium is tinged with brown. *Pipistrellus curtatus* Miller, 1911 from Engano Island also seems very close to *P. macrotis* and it seems evident that an adequate representation of the three taxa might show them to be conspecific.

Philetor brachypterus verecundus (Chasen, 1940)

Eptesicus verecundus Chasen, 1940 : 53. Mount Kledang, Perak, Malaya, 2646 ft.

SPECIMEN EXAMINED. ♀ BM(NH) 83.352 Sepilok, Sabah (in alcohol, skull extracted).

REMARKS. Bornean records of *Philetor brachypterus* were reviewed by Hill (1983): this specimen represents the fourth reported occurrence of the species in Borneo and the second report from Sabah, there being a previous record from Poring, Kinabalu National Park at Ranau. This female from Sabah agrees favourably in cranial size with the female holotype (BM(NH) 47.1437) of *P. b. verecundus* and with female examples from Nepal and Malaya measured by Koopman (1983).

Measurements: length of forearm 32·1; greatest length of skull 14·1; condylobasal length 13·8; condylocanine length 13·3; width across anteorbital foramina 4·7; width across supraorbital tubercules 7·1; least interorbital width 4·5; zygomatic width 10·0; width of braincase 7·8; mastoid width 8·8; c^1–c^1 (alveoli) 5·0; m^3–m^3 7·1; c–m^3 4·5; length complete mandible from condyles 9·6; length right ramus from condyle 10·1; c–m_3 4·7.

Hesperoptenus blanfordi (Dobson, 1877)

Vesperugo (Hesperoptenus) blanfordi Dobson, 1877 : 312. Tenasserim, Burma.

SPECIMENS EXAMINED. ♂♂ BM(NH) 83.353, CMF 830410.4 Sepilok, Sabah (in alcohol, skulls extracted); ♀ CMF 821229.2 Sepilok Laut, Sabah (in alcohol, skull not available); ♀♀ CMF 0029–0031 Witti Range (in alcohol, skulls extracted).

REMARKS. There is no previous record of *Hesperoptenus blanfordi* from Borneo, the species being known hitherto from Burma, Thailand and Malaya. Hill (1976) examined the species in some detail. It may be readily recognized by its small size, densely haired internarial region and anteriorly directed, pointed tragus; the upper surface of the forearm is densely haired and there is a broad, cushion-like pad at the base of the thumb; the braincase is flattened and the small outer upper incisor (i^3) is inwardly displaced to lie behind the inner tooth (i^2), alongside the antero-internal face of the canine. These Bornean examples are smaller in some respects than Thai and Malayan specimens measured by Hill (1976) and sometimes have slightly smaller teeth, especially the inner upper incisors (i^{2-2}) and canines, although closely approached in this by some continental examples.

External measurements of six specimens: length of forearm 24·2–26·4; thumb (c.u.) 3·8–4·0; II^{m} 23·0–24·4; III^{m} 23·4–25·6; III^{1} 12·6–14·3; III^{2} 7·6–8·5; IV^{m} 23·4–24·9; V^{m} 22·8–24·1.

Cranial measurements of five specimens (except where indicated in parentheses): greatest length of skull 12·1–12·6; condylocanine length 11·4–11·8; condylobasal length 11·2–11·6; length orbit-gnathion 2·9–3·1; width across anteorbital foramina 4·6–4·9; width across front of orbits 5·7–6·1; width across supraorbital swellings 5·8–6·0; zygomatic width —; least interorbital width 4·4–4·6; width of braincase 7·2–7·5; height of braincase 4·4–4·9; mastoid width 7·3–7·7; c^1–c^1 (alveoli) 3·9–4·1; m^3–m^3 5·5–6·1; c–m^3 4·0–4·2; length complete mandible from condyles 8·1–8·3 (3); length right ramus from condyle 8·7–8·9 (4); c–m_3 4·4–4·5.

The baculum (Fig. 2) of *Hesperoptenus blanfordi* has not hitherto been examined: those of the remaining species excepting *H. gaskelli* Hill, 1983 were described and illustrated by Hill (1976). Baculum with long, slender, ventrally fluted shaft, the tip expanded both vertically and horizontally, its base expanded into broad, paired flanges separated by a shallow V-shaped aperture. The baculum of *H. blanfordi* combines some features of that of *H. doriae* which has a similar slender shaft with a transversely convex upper surface and a slightly transversely concave lower surface with those of *H. tomesi* in which the baculum has similarly well developed paired basal flanges.

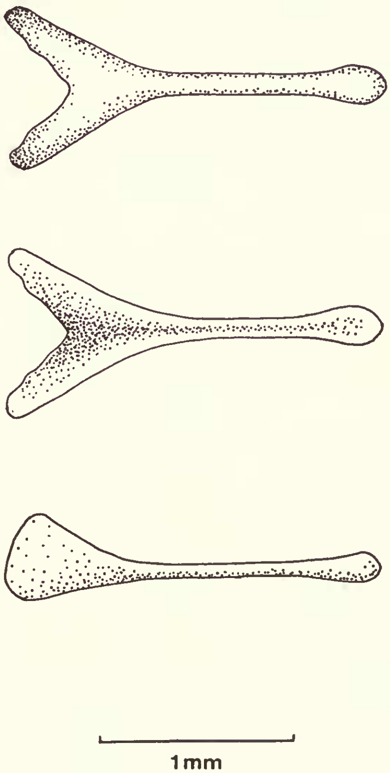

Fig. 2 Dorsal (above), ventral (centre) and right lateral (below) aspect of the baculum of *Hesperoptenus blanfordi*, CMF 830410.4, Sabah.

Hesperoptenus tomesi Thomas, 1905

Hesperoptenus tomesi Thomas, 1905 : 575. Malacca. Malaya.

SPECIMENS EXAMINED. ♀, ♂ CMF 821021.1–2 Lumerau, Sabah (in alcohol, skull of CMF 821021.1 extracted).

REMARKS. There is but one previous record of *Hesperoptenus tomesi* from Borneo, based on a juvenile male example from the Sapagaya Forest Reserve, Sabah, at 5°37′ N, 118°04′ E. Initially reported as *H. doriae* by Davis (1962), this specimen proved on further examination to represent *H. tomesi* (Hill, 1972, 1976). These specimens from Lumerau confirm the occurrence of the species in Sabah: in size they agree closely with Malayan examples measured by Hill (1976).

Measurements (CMF 821021.1–2, skull of 821021.1): length of forearm 53·2; 52·8; greatest length of skull 21·5; condylocanine length 20·5; condylobasal length 20·4; length orbit-gnathion 5·3; width across anteorbital foramina 7·5; width across front of orbits 10·7; width across supraorbital swellings 9·4; zygomatic width 15·5; least interorbital width 5·8; width of braincase 10·5; height of braincase 7·8; mastoid width 12·2; c^1–c^1 (alveoli) 8·0; m^3–m^3 10·6; c–m^3 8·5; length complete mandible from condyles 16·0; length right ramus from condyle 16·8; c–m_3 9·5.

Murina suilla (Temminck, 1840)

Vespertilio suillus Temminck, 1840 : 224, pl. 56, figs 4–6. Tapos, Java.

SPECIMENS EXAMINED. 2♂♂, 2♀♀ CMF 830325.2, 830413.1, 0043, 830804.8 Gomantong; ♂ CMF 0127 Sepilok; ♀ CMF 830114.6 Segarong; ♂ CMF 821222.3 Silau Silau Trail, Mount Kinabalu, 5000 ft, all Sabah (all in alcohol, skulls of CMF 830325.2, 830413.1, 830114.6, 821222.3 extracted); ♂ Rijksmuseum van Natuurlijke Historie (RMNH) 32236 Near Poring hot springs, Kinabalu National Park, Sabah, c. 600 m (in alcohol, coll. F. Rozendaal).

REMARKS. Medway (1977) quotes records of *Murina suilla* from Peleben, Sungei Kayan and from the lower Sungei Mahakam, both localities in East Kalimantan.

Measurements of eight specimens and four skulls (except where indicated): length of forearm 28·8–30·2; greatest length of skull 14·1–14·6; condylobasal length 12·6–13·3 (3); condylocanine length 12·1–12·8 (3); length orbit-gnathion 3·8–4·0; palatal length 6·7–7·3; width across anteorbital foramina 3·7–3·9; rostral width at lachrymals 4·7–5·0; least interorbital width 3·9–4·1; zygomatic width 8·0–8·5; width of braincase 7·0–7·1; height of braincase 6·0–6·2 (3); mastoid width 7·3–7·4 (3); c^1–c^1 (cingula) 3·6–3·7, (alveoli) 3·5–3·6; m^3–m^3 5·0–5·1; c–m^3 4·7–4·9; length complete mandible from condyles 9·1–9·6; length right ramus from condyle 9·6–10·0; c–m_3 5·2–5·5.

Murina cyclotis peninsularis Hill, 1964

Murina cyclotis peninsularis Hill, 1964 : 55. Ulu Chemperoh, near Janda Baik, Bentong District, Pahang, Malaya, c. 3°18′ N, 101°50′ E, 2000 ft.

SPECIMENS EXAMINED. ♀ CMF 8307 Sepilok, Sabah (in alcohol, skull extracted); ♂ CMF 830131.2 Lumerau, Sabah (in alcohol).

REMARKS. *Murina cyclotis peninsularis* was first recorded from Borneo by Hill (1983) who reported two specimens, one from the Gunung Mulu National Park in Sarawak and the other from Sepilok in Sabah.

Measurements (CMF 8307, 830131.2, skull of 8307): length of forearm 36·0, 37·8; greatest length of skull 18·2; condylobasal length 16·9; condylocanine length 16·2; length orbit-gnathion 4·5; palatal length 9·3; width across anteorbital foramina 4·8; rostral width at lachrymals 6·0; least interorbital width 4·5; zygomatic width 10·8; width of braincase 8·0; height of braincase 7·4; mastoid width 9·0; c^1–c^1 (cingula) 5·0, (alveoli) 4·7; m^3–m^3 5·8; c–m^3 5·9; length complete mandible from condyles 12·5; length right ramus from condyle 12·8; c–m_3 6·5.

Murina aenea Hill, 1964

Murina aenea Hill, 1964 : 57. Ulu Chemperoh, near Janda Baik, Bentong District, Pahang, Malaya, c. 3°18′ N, 101°50′ E, 2000 ft.

Specimens examined. ♂♂ BM(NH) 83.359, CMF 830105.2 Sepilok; ♀ CMF 830117.1 Segarong; ♂♂ CMF 830628.3–4 Rinangisan, all Sabah (all in alcohol, skulls of BM(NH) 83.359, CMF 830105.2, 830117.1, 830628.3 extracted).

Remarks. This species has not before been reported from Borneo, being known hitherto only from the holotype and from a second specimen (now BM(NH) 75.2148) from Ulu Gombok, 16 m NE of Kuala Lumpur, Selangor, Malaya, reported by Sly (1975), but who gave few details of the specimen. This second Malayan example is very similar to the male holotype but the bronze tipping of the pelage on the lower back is slightly eroded: the specimen has, however, a prominent 'fringe' of longer, bronze-ochraceous hairs along the base of the tail membrane, a feature that is lacking from the holotype, and in some respects its skull is slightly larger than that of the holotype. These Bornean examples, although preserved in alcohol, display nevertheless the dark based, bronze tipped dorsal pelage of *Murina aenea,* sometimes with a 'fringe' of longer hairs that are more heavily tipped with bright bronze ochraceous along the base of the tail membrane. Ventrally the pelage is basally dark brown, tipped anteriorly with buffy or pale buff brown and posteriorly usually with a more ochraceous tinge.

Measurements of five specimens and four skulls (except where indicated), followed by those of the second Malayan example (BM(NH) 75.2148): length of forearm 35·4–37·9, 35·0: greatest length of skull 16·7–17·6; 17·5; condylobasal length 15·3–16·1, 15·9; condylocanine length 14·7–15·7, 15·4; palatal length 8·3–8·6 (3), 8·6; length orbit-gnathion 4·2–4·3, 4·4; width across anteorbital foramina 4·5–4·8, 4·6; rostral width at lachrymals 5·6–6·0, 5·8; least interorbital width 4·2–4·6, 4·7; zygomatic width 10·3–10·5, 10·7; width of braincase 7·6–8·2, 7·7; height of braincase 6·8–6·9, 6·6; mastoid width 8·3–8·9, 8·6; c^1–c^1 (cingula) 5·1, 5·0, (alveoli) 4·7–4·8, 4·8; m^3–m^3 6·2–6·3, 6·2; c–m^3 5·7–6·0; 6·0; length complete mandible from condyles 11·5–11·7, 12·0; length right ramus from condyle 12·0–12·1, 12·4; c–m_3 6·3–6·5, 6·7.

Murina rozendaali sp. nov.

Holotype. ♂ BM(NH) 83.360 Gomantong, Sabah, 5°31′ N, 118°04′ E. Collected 25 April 1983 by C. M. Francis. Original number CMF 830325.1. In alcohol, skull extracted.

Other material. ♀ CMF 830403.1 From the type locality (in alcohol, skull extracted); ♀ Rijksmuseum van Naturlijke Historie (RMNH) 32235 Near Poring hot springs, Kinabalu National Park, Sabah, *c.* 600 m (in alcohol, skull extracted; coll. F. Rozendaal).

Diagnosis. Externally very similar to *Murina aenea* Hill, 1964 from Malaya but slightly smaller, the pelage longer, more lank and less close and dense; skull like that of *M. aenea* but considerably smaller and narrower, the braincase smaller and less inflated, the rostrum lower and less massive; anterior narial and pre-palatal emarginations shallower and relatively wider; anteorbital foramen separated from orbit by a narrow, not broad bar of bone as it is in *M. aenea*; zygomata much less sharply expanded; post-palatal extension narrower; mandible much less massive than in *M. aenea,* with slender, linear angular process rather than the massive, quadrangular structure of that species; and coronoid process low and broad, not high as in *M. aenea*. Externally *M. rozendaali* is similar to *M. aurata* from the continental mainland but differs from this species in its white, not dark ventral surface; in greater cranial size; in a broader rostrum with the upper toothrows not strongly convergent anteriorly but instead more nearly parallel; in the position of the outer upper incisors (i^{3-3}) which lie more nearly alongside the inner teeth (i^{2-2}) rather than behind them, the front faces of the four teeth lying almost on a transverse line across the longitudinal axis of the skull; and in having the anterior premolars ($pm\frac{2}{2}$) very much less reduced.

Description. Size small (length of forearm 32·1–33·1); nostrils strongly tubular; muzzle slightly swollen laterally, the swellings bearing a number of long vibrissae; ear long and broad, the anterior margin strongly convex, with a small quadrangular lobe at its base, the tip rounded; posterior margin distally convex above an angular notch, curving convexly below this notch to an angular insertion on the head above and some distance behind the angle of the mouth. Tragus long, its length about one half of the length of the ear, acutely pointed, its anterior margin straight for most of its length but slightly convex just below tip; posterior margin slightly concave just below tip but otherwise straight to widest part of tragus, distally faintly serrated; below widest point tragus narrowing abruptly to a small projection on its posterior margin, just above the base.

Pelage both dorsally and ventrally long and woolly; on face, crown, nape and back (from specimens in alcohol) hairs dark brown based, heavily tipped anteriorly with shining golden brown, bronze or ochraceous bronze, the tipping on the lower back slightly less extensive and of a slightly darker bronze hue; hairs on flanks beneath wing insertion similarly dark based but with buffy white tips, on remainder of ventral surface from chin, throat and chest to inguinal region hairs white to the base, sometimes tinged with buffy. Dorsal surface of forearm with a sprinkling of bright golden brown hairs, dorsal surface of tail, tibiae and feet quite densely clothed with longer hairs of a similar colour; dorsal surface of uropatagium with a moderate covering of long, bright brown or golden brown hairs. The overall coloration is very similar to that of *Murina aenea* but the ventral pelage is more extensively white based, and the fur on the tail, tibiae and feet is rather longer.

Skull with narrow braincase, wide interorbital region and short, narrow rostrum; a shallow frontal depression; narial emargination short and wide, shallowly U-shaped; zygomata narrow, not flaring sharply from the sides of the skull; anteorbital foramen only narrowly separated; palate narrow, with wide, shallow U-shaped anterior emargination extending posteriorly to a line joining the centres of the canines; upper toothrows only slightly convergent anteriorly; post-palatal extension narrow, with V-shaped palation, its apex broad with a small median post-palatal spicule; shallow basioccipital pits. Mandible with narrow, rather slender horizontal ramus, the angular process narrow and linear, the coronoid process rather low, broad, with a wide, rounded tip.

Inner upper incisor (i^2) small, with large main cusp and a trace of a posterior cusp; outer upper incisor (i^3) much larger, about twice or a little more as massive as the inner tooth, with small postero-internal cusp, situated almost alongside i^2 so that the anterior faces of the incisors lie almost on a straight line across the longitudinal axis of the skull; posteriorly i^3 is pressed tightly against the canine, which is not especially large and lacks any well developed cingulum on its anterior, internal or posterior faces. Anterior upper premolar (pm^2) equal in crown area to a little more than one half of the crown area of the second upper premolar (pm^4) and about equal to this tooth in height; pm^4 equal in crown area to a little less than two thirds the crown area of the first upper molar (m^1), unlike *Murina aenea* in which the crown area of pm^4 almost equals that of m^1; upper molars (m^{1-3}) with no especial peculiarities. Lower incisors small, imbricated, i_1 and i_2 clearly tricuspid, i_3 with three irregular, poorly developed surface cusps, i_{1-2} about half as wide as long, i_3 almost as wide as long; lower canine with narrow internal cingulum; crown area of anterior lower premolar (pm_2) about half that of the second lower premolar (pm_4), of pm_4 a little more than one half of the crown area of the first lower molar (m_1); hypoconids and entoconids of m_{1-2} clearly apparent and distinct, separated from the protoconids and metaconids by a wide and moderately excavated trough.

Measurements of the holotype, followed by those of CMF 830403.1 and RMNH 32235, in that order: length of forearm 32·1, 32·3, 33·1; length of ear 12·6, 13·2, 12·8; length of tibia 17·8, 18·0, 17·9; length of foot (c.u.) 8·5, 8·5, 8·8; greatest length of skull 15·7, 15·6, 16·0; condylobasal length 14·4, 14·4, 14·6; condylocanine length 14·1, 14·0, 14·0; palatal length 7·8, 7·7, 8·0; length orbit-gnathion 3·9, 4·0, 4·1; width across anteorbital foramina 4·4, 4·3, 4·4; rostral width at lachrymals 4·9, 4·8, 5·0; least interorbital width 4·1, 4·2, 4·1; zygomatic width 9·1, 9·4, 9·3; width of braincase 7·3, 7·5, 7·5; height of braincase 6·2, 6·1, 6·1; mastoid width 7·5, 7·8, 7·8; c^1–c^1 (cingula) 4·1, 4·0, 4·4, (alveoli) 3·8, 3·7, 4·1; m^3–m^3 5·4, 5·4, 5·5; c–m^3 5·2, 5·3, 5·6; length complete mandible from condyles 10·5, 10·5, 10·4; length right ramus from condyle 10·9, 10·9, 10·9; c–m_3 6·0, 5·9, 6·1.

ETYMOLOGY. This species is named after Mr Frank Rozendaal of the Rijksmuseum van Natuurlijke Historie, Leiden, who while visiting the Kinabalu National Park in Sabah collected the first specimen to be obtained.

DISCUSSION. The genus *Murina* was briefly reviewed by Tate (1941*b*), who provided a key with notes on selected species. Since then Hill (1964) has examined its members in south-eastern Asia, with the description of a further subspecies of *M. cyclotis* (*M. c. peninsularis*) and of a further species (*M. aenea*) from Malaya, while Van Deusen (1961) and Hill (1983) have reviewed the forms occurring east of Wallace's Line. Yoshiyuki (1970) has described *M. tenebrosa* from the Tsushima Islands and more recently (1983) has proposed *M. silvatica* for members of the *aurata* group from Japan, and Maeda (1980) has reviewed *M. aurata* and its associated forms. Currently as few as eleven (Corbet & Hill, 1980) or as many as fifteen (Honacki *et al.*, 1982) species of *Murina* are recognized, excluding the more recently described *M. silvatica* Yoshiyuki, 1983.

Specimens in the British Museum (Natural History) indicate that the members of the genus so far examined fall cranially and more especially dentally into two groups. One is of generally small species in which the rostrum is rather narrow and the upper toothrows markedly convergent anteriorly. The inner upper incisor (i^2) lies distinctly anterior to the outer upper incisor (i^3), with its postero-external face abutting the antero-internal face of i^3, and the anterior premolars (pm$\frac{2}{2}$) are much reduced. The group includes *leucogaster, aurata, florium, suilla* (including *canescens* and *balstoni*), and probably also *ussuriensis, tenebrosa* and *silvatica,* but these latter three have not been examined. Although in most respects in good agreement with this group, *tubinaris* has upper incisors that begin to approach those of the second group. In this group the rostrum is broad anteriorly, the toothrows more nearly parallel, and i^3 is situated more laterally to i^2 so that at the extreme its inner face lies more or less alongside the outer face of that tooth, with pm$\frac{2}{2}$ less reduced. This group includes *huttonii, cyclotis, aenea* and *rozendaali:* the incisors of *huttonii* and *cyclotis* are similar in relative position to those of *tubinaris* but in *aenea* and *rozendaali* i^3 lies almost totally alongside the outer face of i^2. There is thus a gradual change in the position of i^3 in relation to i^2, perhaps related to shortening and broadening of the rostrum: in *M. cyclotis cyclotis* i^3 is situated partly alongside and partly behind i^2 but in the larger *M. c. peninsularis* which has a rather broader rostrum i^3 tends in position towards the more extreme condition of *aenea* or *rozendaali.* The new species belongs quite clearly to the latter group: like *M. aenea,* to which it appears closely related, in its external appearance it resembles *M. aurata,* but, like *M. aenea,* it differs sharply from that species in the details of its cranial and dental architecture.

Harpiocephalus (?) mordax Thomas, 1923

Harpiocephalus mordax Thomas, 1923 : 88. Mogok, Upper Burma.

SPECIMEN EXAMINED. ♀ CMF 0099 Sepilok, Sabah (in alcohol, skull extracted).

REMARKS. The genus *Harpiocephalus* has been recorded once before from Borneo, by Medway (1977) who referred a specimen from Quoin Hill Cocoa Research Station, near Tawau, Sabah to *H. harpia* (Temminck, 1840). Medway remarked that the specimen was assigned to the nominate subspecies *H. h. harpia* on the basis of Tate's (1941*b*) description of a near topotype from Java, which it closely resembled in all salient characters. The specimen was first reported without taxonomic comment by Tan (1966) who examined its stomach contents.

This old adult specimen from Sepilok, however, agrees much more readily with *Harpiocephalus mordax* Thomas, 1923, described from Burma and represented in London only by the holotype (BM(NH) 4.4.27.1) and by one other specimen (BM(NH) 4.4.27.2), also from the type locality. This species was characterized by Thomas as having the skull markedly larger than in *H. harpia,* with bigger crests and more widely expanded zygomata, the muzzle much developed, and broad and heavy. According to Thomas, the anterior teeth, the incisors and canines are much enlarged, very stout and heavy, and even the premolars are slightly broader than the first molar, being narrower in *H. harpia*. The posterior molar was said to be not quite so minute as in the latter.

The specimen from Sepilok complies in most respects with this definition: in particular the muzzle is much broadened and more massive in comparison with the limited series of *Harpiocephalus harpia* in London, and the zygomata are much more widely expanded. The anterior teeth, especially the canines, are heavier and altogether more massive than in *H. harpia.* Re-examination of the two original specimens studied by Thomas suggests, however, that the cranial crests are little more developed in *mordax* than in the oldest of *H. harpia* and that although cranially *H. mordax* is larger in most respects than *H. harpia*, its greatest size differences are clearly chiefly those that relate to the width of the muzzle and zygomata. The Bornean example differs from Burmese *H. mordax* in the smaller size of m^3, which in this specimen is reduced to little more than a mere flake. In life, this specimen was conspicuous for its bright orange coloration.

Measurements of CMF 0099, with those of the holotype of *Harpiocephalus mordax* and of the second Burmese example, in that order, followed (in parentheses) by the measurements of five examples of *H. harpia* from Java and of the lectotype and topotypes of *harpia* (five specimens except where indicated) as measured by Husson (1955): length of forearm 48·2, 54·1, 50·7, (43·4–49·7; (4) 45·0–49·5); greatest length of skull 22·3, 23·2, 22·4, (20·6–22·3; (4) 20·4–21·6); condylobasal length 20·6, 21·1, 20·3, (18·4–20·3; (4) 18·8–19·8); condylocanine length 19·8, 20·3, 19·7, (18·0–19·5; (4) 18·3–19·1); basal length 18·1, 18·9, 18·4, (16·4–18·4; (3) 17·3–17·5); palatal length 11·4, 12·3, 11·3, (10·4–11·6; (4) 11·0–11·7); length palatal bridge (from rear of incisive foramen to palation) 9·3, 10·4, 9·2, (8·7–9·6; —); width across anteorbital foramina (? lachrymal width of Husson) 7·3, 6·8, 6·8, (5·9–6·5; 5·8–6·2); width across supraorbital tubercles 8·3, 8·1, 7·9, (7·0–7·7; —); least interorbital width 5·3, 5·5, 5·6, (5·3–5·7; 5·3–5·7); zygomatic width 14·6, 14·3, 14·9, (12·5–13·7; 13·1–13·6); width of braincase 10·2, 9·6, 9·9, (9·2–9·8; (4) 9·2–10·1); height of braincase 8·8, 8·9, 9·2, (8·4–8·9; (4) 8·6–8·8); mastoid width 12·0, 11·5, 11·8, (10·3–11·6; (3) 10·5–11·2) c^1–c^1 (alveoli) 7·8, 7·1, 7·2, (6·1–6·6; —); (cingula) 7·5, 7·2, 7·3, (6·1–6·6; 6·2–6·7); m^2–m^2 8·0, 7·7, 7·7, (6·9–7·4; 7·2–7·3); c–m^3 6·9, 7·4, 7·2, (6·3–6·5; 6·7–6·9); length complete mandible from condyles 15·4, 16·1, 15·6, (13·9–15·0; —); length right ramus from condyle 16·1, 16·5, 16·2, (14·3–15·6; 14·5–15·6); coronoid height 9·5, 9·2, 9·3, (7·8–8·5; 7·6–8·6); c–m_3 ·8·0, 8·3, 8·2, (7·4–7·9; 7·7–7·8).

The specimen from Quoin Hill Cocoa Research Station reported by Medway (1977) as *Harpiocephalus harpia* is in the collections of the University of Malaya. It is a mature if not somewhat aged individual, its teeth quite worn. In size and especially in the width of the skull it agrees closely with specimens of *H. harpia* from Java: length of forearm 47·7; greatest length of skull 22·1; c^1–c^1 (alveoli) 6·0; m^2–m^2 7·1; c–m^3 6·6.

DISCUSSION. The systematics of *Harpiocephalus* remain unclear. The genus is generally poorly represented in collections and appears to be rarely collected. It was last examined in any detail by Tate (1941*b*) who described specimens from Java and northeastern India and who gave notes on the supposed type material of *H. harpia* in the Rijksmuseum van Natuurlijke Historie, Leiden: this was later examined by Husson (1955) who designated a lectotype.

Ellerman & Morrison-Scott (1951) considered the genus to be monospecific, with four definite subspecies, namely *Harpiocephalus harpia harpia* (Temminck, 1840) in the eastern part of the range from Sumatra and Formosa east to the Molucca Islands, *H. h. rufulus* Allen, 1913 from Indochina, *H. h. lasyurus* (Hodgson, 1847) from northeastern India, and *H. h. madrassius* Thomas, 1923 from southern India. These authors thought *mordax* to be a possible subspecies of *H. harpia*. More recent compilers (Corbet & Hill, 1980, Honacki *et al.,* 1982) have followed this lead and have listed *Harpiocephalus* with but a single species. The material available is quite inadequate to establish the extent of individual variation. However, neither the holotype nor the paratype of *H. mordax* is an especially old individual, and an example (BM(NH) 9.1.5.359) of *H. harpia harpia* in the collections in London, of similar age, shows no evidence of rostral widening to resemble *H. mordax.* The Burmese, Bornean and most of the Javan and other specimens examined are female but there is no suggestion of rostral broadening in one male (BM(NH) 9.1.5.356) of *H. h. harpia* from Java or in another (BM(NH) 16.7.29.42) of *H. h. lasyurus* from northeastern India. The principal distinguishing characteristic of *H. mordax* does not therefore appear to be an age or sex related feature.

Kerivoula minuta Miller, 1898

Kerivoula minuta Miller, 1898 : 321. Trong (=Trang), Peninsular Thailand.

Specimens examined. ♂ BM(NH) 82.558, ♀ CMF 0051 Gomantong (in alcohol, skulls extracted); ♂♂ CMF 830221.1, 830223.1–3 Baturong (in alcohol, skulls extracted); ♂♂ CMF 821106.01, 821107.06 in alcohol, skulls extracted but not available in London), 821127.5–6 (in alcohol, skull of 821127.5 extracted) Madai; ♂ CMF 0028 Witti Range (in alcohol), ♀ CMF 830113.1 (in alcohol, skull extracted but not available in London), ♂♂ 830114.8 (in alcohol, skull extracted), 830114.9 (in alcohol, skull extracted but not available in London) Segarong; ♂♂ BM(NH) 83.354–355 (in alcohol, skulls extracted), CMF 821017.1 (alcohol, skull extracted but not available in London) Lumerau; ♂♂ CMF 821022.2–3 Silabukan (in alcohol, skulls extracted but not available in London); all in Sabah.

Remarks. Medway (1977) first recorded *Kerivoula minuta* from Borneo on the basis of a single specimen (now BM(NH) 76.307) obtained 12 miles N of Kalabakan, Tawau, Sabah. These further specimens confirm this initial report and agree closely with those from Malaya reported by Hill (1965). The smallest examples of this species are little larger than *Craseonycteris thonglongyai* Hill, 1974*b*, generally accepted as among the smallest if not the smallest of bats.

Measurements appear in Table 4.

Kerivoula intermedia sp. nov.

Holotype. ♂ BM(NH) 83.356 Lumerau, Sabah, 5°12′ N, 118°52′ E. Collected 6 February 1983 by C. M. Francis. Original number CMF 830206.4. In alcohol, skull extracted.

Other material. Sabah: ♀, ♂ CMF 821016.3–4, ♀♀ 821021.4–5 (in alcohol, skulls extracted but not available in London), ♀ BM(NH) 83.357 (in alcohol, skull extracted). From the type locality. ♂, ♀ CMF 0013, BM(NH) 82.559 (in alcohol, skulls extracted), ♂♂, ♀ CMF 830103.1–3, ♂ 830108.1 (in alcohol skulls extracted but not available in London) Sepilok; ♂♂ BM(NH) 82.560 (in alcohol, skull extracted, ♂♂ CMF 0026–0027 (in alcohol) Witti Range; ♀ CMF 821022.1 Silabukan (in alcohol, skull extracted but not available in London).

Malaya: ♂ BM(NH) 71.1134 Tekam Forest Reserve, Jerantut, Pahang; ♀ BM(NH) 75.1295 Sungei Kelembang Camp, Ulu Setiu, Besut, Trengganu, c. 5°25′ N, 116°30′ E (both in alcohol, skulls extracted).

Diagnosis. Externally, cranially and dentally similar to *Kerivoula minuta* Miller, 1898 from Malaya and Borneo, but skull larger, intermediate in size between *K. minuta* and *K. pellucida* (Waterhouse, 1845); differs from *K. minuta* in more elongate, less globular braincase, in longer rostrum that is broader, especially posteriorly, with deeper narial emargination; in longer, wider palate with wider, more substantial bony post-palatal extension; and in larger and more massive teeth. Although in length of forearm the largest of *K. intermedia* overlap the smallest of *K. pellucida,* the ears of *K. intermedia* are smaller, more rounded and like those of *K. minuta,* the skull and teeth smaller than in *K. pellucida,* the braincase much less inflated, the rostrum lower and broader, the palate wider in relation to its length and in particular *K. intermedia* has a broad post-palatal extension that contrasts sharply with the very narrow extension of *K. pellucida.*

Description. Size small (length of forearm (18) 26·7–30·7; in *Kerivoula minuta* (23) 24·8–29·3); ear short for *Kerivoula* (length of ear (18) 9·0–11·4; in *K. minuta* (23) 8·2–9·9), closely similar to ear of *K. minuta*, rounded, funnel-shaped, the anterior margin strongly and evenly convex, rising to blunt, obtuse point; posterior margin of ear with shallow, obtusely angular emargination just below tip, otherwise convex. Tragus long, about three quarters or a little more as long as the ear, its rounded tip about level with the shallow emargination in the posterior margin of the ear, anterior margin of tragus slightly convex proximally, straight for most of its length; posteriorly a prominent tooth-like projection at widest point of tragus, the posterior margin slightly concave above this basal projection. Wing inserted at base of first toe, as in *K. minuta;* as in that species the calcar is long, extending along about two thirds of the uropatagial margin between foot and tail.

Dorsal pelage (from specimens in alcohol) mid-brown, the hairs faintly lustrous, darker basally; ventral surface similarly mid-brown to slightly darker brown, the hairs dark greyish brown at the base and for about one half of their length, otherwise bright paler brown, the basal colour sometimes evident. Proximal part of dorsal surface of uropatagium and dorsal surface of tibiae with a sprinkling of long, golden brown hairs, the ventral uropatagial surface with a few shorter, similarly coloured hairs; uropatagium lacking any marginal fringe.

As in *Kerivoula minuta* the skull is small, short and wide, although the braincase and to a lesser extent the rostrum are more elongate than in that species; braincase slightly inflated posteriorly, slightly elongate anteriorly; rostrum low and broad, posteriorly slightly inflated but not expanded anteriorly; anterior narial emargination narrow, deep, U-shaped, rounded posteriorly; a very shallow median sulcus; zygomata strong and quite massive, lacking any jugal projection; palate long, narrowed anteriorly, widened at level of posterior upper premolars (pm^{4-4}), with broad bony post-palatal extension and wide mesopterygoid fossa; shallow basioccipital pits; width of cochleae about one and one half times their distance apart.

Inner upper incisor (i^2) with strong principal cusp and a well developed posterior supplementary cusp extending for about one half the height of the main cusp; outer upper incisor (i^3) a little greater in base area than i^2 and three quarters its height, its tip slightly exceeding the posterior supplementary cusp of that tooth, with well developed cingulum but no cingulum cusps, scarcely separated from the canine; as in *Kerivoula minuta* the first and second lower incisors (i_{1-2}) lie more or less along the line of the toothrow, which is strongly arched forward, but the third tooth (i_3) lies slightly transversely to it; i_{1-2} tricuspid, i_3 a little more massive, with small antero-internal cusp but insignificant postero-external cusp. Anterior premolars ($\mathrm{pm}\frac{2}{2}$) more or less circular in outline, the longitudinal diameter of pm^2 very slightly less than its transverse diameter, these about equal in pm_2; longitudinal diameters of second premolars ($\mathrm{pm}\frac{3}{3}$) and posterior premolars ($\mathrm{pm}\frac{4}{4}$) slightly exceeding their transverse diameters; crown area of pm^3 very slightly exceeding that of pm^2, that of pm_3 and pm_2 about equal; upper premolars slightly compressed in toothrow, the lower premolars less so; lingual margins of m^1 and m^2 rounded, the teeth separated by a wide embrasure.

Measurements appear in Table 4.

ETYMOLOGY. The name selected for this new species reflects the size of its skull, which lies between that of the very small *Kerivoula minuta* and the larger *K. pellucida*.

DISCUSSION. Malayan specimens of this new species have been in the collections of the British Museum (Natural History) for some years. However, there were at the same time no more than three Malayan examples in London of the small form here recognized as *Kerivoula minuta* and only one further specimen from Sabah, so that no real evaluation of their differences could properly be made. Further specimens of both groups from Sabah show that two taxa are involved and although some of their differences are subtle they may be clearly distinguished, a point first remarked by one of us (CMF) who found a considerable difference in weight when examining newly collected examples.

Phoniscus atrox Miller, 1905

Phoniscus atrox Miller, 1905 : 230. Vicinity of the Kateman River, eastern Sumatra.

SPECIMENS EXAMINED. ♀ CMF 821106.06 Madai (in alcohol, skull extracted); ♀ BM(NH) 83.77 Sepilok

Table 4 Measurements of *Kerivoula intermedia* and *K. minuta*

	K. intermedia ♂ BM(NH) 83.356 Holotype. Sabah	*K. intermedia*		*K. minuta*	
		♂♂	♀♀	♂♂	♀♀
Length of forearm	27·7	(10) 26·7–29·5	(8) 28·6–30·7	(19) 24·8–28·3	(4) 28·4–29·3
Length of ear	9·8	(10) 9·0–10·4	(8) 9·6–11·4	(19) 8·2–9·7	(4) 9·1–9·9
Greatest length of skull	12·1	(8) 11·8–12·3	(7) 11·8–12·4	(17) 10·7–11·2	(3) 11·2–11·6
Condylobasal length	11·4	(8) 11·1–11·8	(7) 11·3–11·8	(17) 10·0–10·8	(3) 10·7–11·1
Condylocanine length	11·0	(8) 10·8–11·2	(7) 10·9–11·5	(17) 9·0–10·4	(3) 10·3–10·8
Palatal length	6·4	(3) 6·4–6·7	(3) 6·4–6·7	(12) 6·0–6·2	(2) 6·1, 6·4
Palation-anterior palatal emargination	—	(2) 5·5, 5·6	(3) 5·4–5·7	(10) 4·8–5·0	(2) 4·8, 5·3
Width across anterorbital foramina	3·0	(3) 3·0–3·3	(3) 2·9–3·2	(11) 2·4–3·1	(2) 2·5, 2·8
Least interorbital width	2·9	(7) 2·6–2·9	(7) 2·6–2·9	(17) 2·5–2·9	(3) 2·6–2·7
Zygomatic width	7·5	(5) 7·4–7·7	(5) 7·5–8·2	(12) 6·6–7·0	(3) 7·3
Width of braincase	5·5	(8) 5·5–5·9	(7) 5·4–5·8	(18) 5·0–5·5	(3) 5·4–5·6
Mastoid width	6·4	(4) 6·4–6·6	(3) 6·4–6·6	(12) 5·9–6·4	(2) 6·2, 6·3
c^1–c^1 (alveoli)	3·0	(4) 2·8–3·1	(7) 2·8–3·2	(19) 2·5–2·9	(3) 2·6–2·7
m^3–m^3	5·0	(7) 4·9–5·1	(7) 4·7–5·3	(18) 4·3–4·8	(3) 4·5–4·8
c–m^3	4·8	(8) 4·6–4·9	(7) 4·6–5·0	(20) 4·1–4·6	(3) 4·3–4·5
Length complete mandible from condyles	8·5	(3) 8·3–8·5	(3) 8·3–8·8	(7) 7·4–7·9	—
Length right ramus from condyle	8·7	(4) 8·5–8·7	(3) 8·5–9·0	(9) 7·7–8·0	(2) 8·1, 8·4
c–m$_3$	5·2	(4) 5·0–5·2	(3) 5·0–5·3	(13) 4·4–4·8	(2) 4·6, 4·8

(in alcohol, skull extracted); ♂ BM(NH) 83.358 (in alcohol, skull extracted), ♀ CMF 830206.2 (in alcohol) Lumerau; all Sabah.

REMARKS. This species has been known hitherto from southern Thailand, Malaya and Sumatra. Specimens from Borneo agree in most respects with those from Thailand and Malaya but are generally a little smaller. Additionally, the braincase in Bornean examples is slightly more elevated frontally than in those from the mainland, with the frontal profile a little more deeply concave; the palate is slightly narrower, especially posteriorly; the outer upper incisor (i^3) is considerably reduced to a narrow spicule; and the maxillary teeth are rather smaller, particularly the molars.

Measurements of CMF 821106.06, BM(NH) 83.77, 83.358 (including skulls) and CMF 830206.2 (forearm only) (in that order), with those (in parentheses) of three (except where indicated) specimens from the Malayan peninsular: length of forearm 31·6, 32·4, 32·3, 32·5, (32·7–34·2); greatest length of skull 14·3, 14·2, 14·4, (14·5–15·2); condylobasal length 13·2, 12·9, 13·1, (13·1–13·8); condylocanine length 13·0, 12·8, 13·0, (13·0–13·7); palatal length 7·6, 7·7, 7·9, (7·9–8·5); least interorbital width 3·6, 3·6, 3·7, (3·8–4·2); zygomatic width 8·2, —, 8·3, (8·5, 8·7, two only); width of braincase 6·8, 6·6, 6·9, (7·0–7·4); mastoid width 7·2, 7·0, 7·2, (7·3–7·5); c^1–c^1 (alveoli) 3·3, 3·4, 3·4, (3·5–3·7); m^3–m^3 5·0, 5·1, 5·0 (5·3–5·5); c–m^3 5·7, 5·6, 5·7, ((5·9–6·1); length complete mandible from condyles 10·1, —, 10·0 (10·5, 10·6, two only); length right ramus from condyle 10·4, —, 10·4, (10·5–11·0); c–m$_3$ 6·1, 6·1, 6·1, (6·3–6·6).

DISCUSSION. *Phoniscus atrox* appears to have been represented in the literature until now by no more than six specimens: the holotype and one other from the type locality in Sumatra, two from Klong Bang Lai, Patiyu, southern Thailand reported in detail by Kloss (1916) and subsequently examined again by Hill (1965), by a subadult from the Ulu Gombak Forest Reserve in Selangor, Malaya, reported by Medway (1969) and finally by one from the Tekam Forest Reserve, Pahang, Malaya, recorded by Hill (1974*a*) and by Medway (1978). Those reported by Kloss (1916) from southern Thailand and by Hill (1974*a*) and Medway (1978) from Pahang are now in the British Museum (Natural History) (BM(NH) 20.7.3.7–8, 71.1135). A direct comparison of specimens from the Malayan peninsular and examples from Sumatra has yet to be made but following Kloss (1916) peninsular specimens have been referred to *P. atrox* with which apparently they agree in all essential respects. Unfortunately, Miller gave no details of the skull or its dimensions in the original account. It seems likely that adequate material might demonstrate that the Bornean and mainland populations are subspecifically distinct but both need to be compared with specimens from Sumatra before any proper decision can be reached.

The only other record of *Phoniscus* from Borneo is of a specimen of *P. jagorii javanus* (Thomas, 1880) from Riam, Kotawaringin district, central Kalimantan, listed by Tate (1941 : 597) who remarks elsewhere (p. 589) in the same paper that there were two specimens from Borneo in the Archbold Collections. However, H. M. van Deusen (in Medway, 1977) reported that only one of these is from Borneo, as listed by Tate: the other is from Bali, as Tate's list shows.

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